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Describing and mapping where people experience tranquillity. An exploration based on interviews and Flickr photographs

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Mapping tranquillity based on interviews and social media data

Abstract

It has been demonstrated that there are health benefits associated with tranquillity, but tranquil areas are increasingly threatened by development. Consequently, the need arises to map areas where people experience tranquillity. As conducting interviews and surveys across large areas is often cost-prohibitive, we examine the utility of social media data in studying tranquillity. For a case study in the Loch Lomond and The Trossachs National Park in Scotland we combined field-based interviews with an analysis of social media data. By asking respondents what made a setting tranquil, we collated a list of words positively associated with tranquillity. Based on this list we selected georeferenced Flickr images with tags matching our keywords and mapped the location of these images. The tranquillity map from social media data portrays areas near large water bodies as tranquil, which corresponds well the responses from field-based interviews. These findings differ from existing noise maps, suggesting that people experience tranquillity despite distractors such as human presence or traffic noise. Based on our findings we propose to distinguish two notions of tranquillity: ‘potential tranquillity’ as modelled using data on land use and infrastructure and ‘experienced tranquillity’, which are areas where people actually experience tranquillity. From a management and planning perspective both approaches have validity and can be combined for an integrated assessment of tranquillity.

Keywords: tranquillity mapping, user-generated content, social media photographs, landscape perception, landscape planning, Loch Lomond and The Trossachs National Park Scotland

1. Introduction

There is an increasing recognition of the restorative qualities of tranquil landscapes (Bieling et al., 2014; Kaplan, 2001; Watts et al., 2013), and areas

4 where people find tranquillity have been shown to provide positive health ef-
5 fects (Seresinhe et al., 2015; Shepherd et al., 2013; Velarde et al., 2007). The
6 protection of tranquil areas has become an important policy objective at the
7 European level, with the Environmental Noise Directive (END) highlighting
8 the importance of protecting such areas (EEA, 2016b). In the UK, tranquil-
9 lity was included in the National Planning Policy Framework (2012, §123).
10 Such is its importance that UK government policy effectively places an obli-
11 gation on local authorities to identify zones of tranquillity in consultation
12 with local communities (Department of Communities and Local Government
13 2012, 52). Existing maps that can be used for such assessments include the
14 ‘quiet areas’ defined by the EEA (2016b). Efforts to model potential tran-
15 quillity are reflected in the Tranquillity Map for England published by the
16 Campaign to Protect Rural England (CPRE, 2007). These maps portray
17 an expert-based view of tranquillity, which does not necessarily reflect re-
18 alities on the ground. This is problematic in the context of protected area
19 management, which is meant to be in response to societal needs.

20 Thus, with the strategic aim to identify and protect areas of tranquillity
21 in the UK and elsewhere, the need arises to provide maps about where such
22 areas exist, and how they can be accessed - these maps then forming an in-
23 tegral part of evidence-based landscape planning and decision-making. We
24 take as an example the case of Loch Lomond and The Trossachs National
25 Park (LLTNP) in Scotland, which has identified the need for a tranquillity
26 map that takes into account people’s experience in order to plan and man-
27 age recreational amenities and further improve overall recreational service
28 provision in the national park (pers. comm. S. Melville, Landscape Officer
29 LLTNP).

30 Qualitative interviews and detailed surveys are well-established methods
31 that might be used to elicit information about where tranquillity is expe-
32 rienced, but interviewing people across large areas is often cost-prohibitive.
33 In this respect, the advent of social media platforms where people upload
34 content about their experiences in different places provides us with a novel
35 data source that can be used to analyse environmental experiences (Dunkel,
36 2015). With the availability of these sources of information, questions arise as
37 to what insights we are able to gain from social media data, and whether such
38 information could eventually be harnessed as a surrogate for more conven-
39 tional sources of geographic information (van Zanten et al., 2016; Wartmann
40 et al., 2018). The ambition of this paper is to illustrate the potential of
41 social media data as a way of exploring the notion of tranquillity as it is

42 experienced. Specifically we aim to:

- 43 1. Demonstrate the role of social media data in describing tranquillity ‘as
44 experienced’
- 45 2. Assess the truthfulness of Flickr geotagged data by comparison with
46 data gathered via questionnaires conducted in the LLTNP
- 47 3. Comment on the efficiency of using Flickr data in gathering large sam-
48 ples, over large geographic extent as compared with field based tech-
49 niques
- 50 4. Illustrate the use of complimentary forms of analysis to explore tran-
51 quillity

52 To address these aims, we developed a hybrid methodology that combines
53 field-based interviews and tranquillity ratings with an analysis of social media
54 data.

55 2. Background

56 In the Oxford English dictionary, tranquillity is defined as ‘*The quality or*
57 *state of being tranquil; freedom from disturbance or agitation; serenity, calm-*
58 *ness; quietness, peacefulness.*’ (<http://www.oed.com/>). From a research
59 perspective, tranquillity has been investigated using a variety of approaches
60 from different fields, including environmental psychology, acoustics, the social
61 sciences, and Geographic Information Science.

62 2.1. Image rating experiments in environmental psychology

63 Kaplan’s attention restoration theory states that natural environments of-
64 fer escape from the pressures of everyday stress. In contrast to urban environ-
65 ments, natural environments are considered to relieve our fatigued attentional
66 capacity through what Kaplan and Kaplan coined ‘soft fascination’ (Kaplan
67 and Kaplan, 1989) - the effortless pleasure of watching a burbling stream,
68 or clouds passing overhead. Herzog and Bosley (1992) explored whether
69 tranquil environments could be distinguished from preferred ones through
70 an image rating experiment of different landscape settings. Preference and
71 tranquillity ratings were highly correlated, but tranquillity was rated higher
72 for certain landscape settings, including scenes showing large water bodies
73 (Herzog and Bosley, 1992). Herzog and Chernick (2000) showed that tran-
74 quillity was rated significantly higher in natural settings than in urban ones,
75 with perceived open space, how well-cared a setting appeared to be and the

76 amount of foliage positively correlated with tranquillity ratings in natural
77 areas.

78 2.2. *Measuring soundscapes*

79 Various researchers have explored the connections between anthropogenic
80 and natural soundscapes and tranquillity. Pheasant et al. (2008) exposed
81 subjects to combinations of imagery and soundscape in order to explore their
82 correlation with tranquillity. They developed a tool for predicting tranquillity
83 based on the naturalness of a scene, and sound pressure levels - the so called
84 TRAPT model (Pheasant et al., 2009), which revealed a linear relationship
85 between increasing tranquillity and naturalness and an inverse relationship
86 with decreasing levels of noise. Watts et al. (2013) explored refinements to
87 the tranquillity prediction tool of Pheasant et al. (2009), examining its utility
88 in urban green spaces. The same methodology was applied in the context
89 of wind farms (Watts and Pheasant, 2015a) and then more broadly in rural
90 contexts (Watts and Pheasant, 2015b). They concluded that soundscape
91 impacts people's sense of tranquillity and should therefore be an integral
92 part of the assessment process.

93 The importance of sound is reflected in the European wide Quietness
94 Suitability Index (QSI) - a model that uses a combination of naturalness and
95 noise modelling (EEA, 2016b).

96 2.3. *Mapping tranquillity*

97 The Campaign to Protect Rural England (CPRE) has been drawing at-
98 tention to tranquillity and tranquil areas since the 1990's (CPRE, 2005;
99 CPRE and the Countryside Commission, 1995; MacFarlane et al., 2004; Jack-
100 son et al., 2008), defining 'tranquil areas' as: '*places which are sufficiently far*
101 *away from the visual or noise intrusion of development or traffic to be consid-*
102 *ered unspoilt by urban influences*' (CPRE and the Countryside Commission,
103 1995). The first mapping was undertaken by Simon Rendel and ASH consult-
104 ing in 1991 for the Department of Transport, showing how significant tracts
105 of land affected by a proposed transport corridor in Central England were
106 undesignated and therefore vulnerable to development. This original work
107 brought to the fore the merits of mapping tranquil areas for policy-making
108 and planning (Rendel, 1998). In producing a set of tranquil area maps for
109 England, the focus was on the impact of audio-visual aspects such as roads,
110 railways, power stations, and large towns on tranquillity in terms of distance
111 thresholds (CPRE and the Countryside Commission, 1995).

112 On behalf of CPRE, Levett (2000) produced a report detailing a num-
113 ber of limitations of the model used to map tranquil areas, which subse-
114 quent mapping projects attempted to address; these included the use of
115 fixed thresholds of distances from noise sources, the failure to model the
116 cumulative effects of multiple low-level noise sources, and expert-based def-
117 initions of criteria and thresholds (Levett, 2000). A subsequent mapping
118 project in the Northumberland National Park and West Durham Coalfield
119 in England sought to address Levett's criticisms and in particular, to include
120 the views of the public (MacFarlane et al., 2004). However, most answers
121 from the public consultation exercise were deemed incompatible with the
122 requirements for a model in a Geographic Information System (GIS). The
123 operationalisation of factors contributing and diminishing tranquillity was
124 thus done by the researchers themselves, with layers weighted according to
125 scores defined through another public consultation phase (MacFarlane et al.,
126 2004). This approach was further developed in a follow-up study a tranquil-
127 lity map for the whole of England produced (Jackson et al., 2008; CPRE,
128 2007). For this national tranquillity map (CPRE, 2007), over 1000 people
129 were consulted in five locations to rate the factors contributing to, and de-
130 tracting from, tranquillity. In order to define the thresholds for the criteria
131 represented as GIS layers (e.g. the distance at which the impact of a road
132 on tranquillity decreases), the study encompassed photo-rating tasks (Jack-
133 son et al., 2008). Another study in the Dorset Area of Outstanding Beauty
134 incorporated views from different stakeholders in the protected area (local
135 authorities and agencies, visitors and residents, including those considered
136 hard to reach), totalling over 800 participants, whose views were assessed
137 through participatory appraisals including focus groups, household and on-
138 site surveys (Hewlett et al., 2017). The on-site surveys identified the im-
139 portance of open landscape, and the absence of anthropogenic noise, traffic
140 and people in influencing visitors' sense of tranquillity. From these data, the
141 information that was deemed quantifiable was represented in a GIS model.
142 Such a mixed-methods approach is valuable to planners and decision-makers
143 because it integrates both qualitative and quantitative data, and using GIS,
144 offers ways to visualise a subjective concept such as tranquillity (Hewlett and
145 Brown, 2018).

146 3. Materials and Methods

147 In this study, we developed a methodology to investigate tranquillity
148 through language-based approaches, linking terms to space via user-generated
149 images, making use of increasingly available volumes of social media data. In
150 what follows, we describe in more detail how we applied this methodology to
151 our case study area of the Loch Lomond and The Trossachs National Park
152 in Scotland.

153 3.1. Study area

154 The Loch Lomond and the Trossachs National Park was created in 2002 as
155 the first national park in Scotland, covering an area of 1865 km². The terrain
156 is varied, with mountains and glens, as well as many saltwater and freshwa-
157 ter lochs, including iconic Loch Lomond. The vegetation includes native
158 woodlands, plantation forests, meadows and agricultural fields. Importantly,
159 the landscapes in the national park are cultural landscapes that have been
160 shaped by people for generations. Currently, over 15,000 people reside in
161 the park (LLTNP, 2017). The landscapes of Loch Lomond have long proved
162 popular for national and international tourists alike, their beauty reflected,
163 for instance, in the writings of Sir Walter Scott (1771-1832). Nowadays the
164 park attracts over 4 million visitors every year (LLTNP, 2017). Although
165 some public transport exists, many areas of the park are difficult to reach,
166 and a recent survey found that over 85% of visitors rely on private transport
167 (LLTNP, 2017).

168 3.2. Selecting locations for field-based interviews and tranquillity ratings

169 To elicit information about how people experience tranquillity, we con-
170 ducted interviews and tranquillity ratings with participants recruited at dif-
171 ferent locations in the park. A map of interview locations is shown in Fig. 1
172 and the landscapes at some of the interview sites are illustrated in Fig. 2.

173 We selected the interview sites as the locations used for viewpoint analy-
174 sis in the ‘Special Landscape Qualities’ report by Scottish Natural Heritage
175 SNH (2010) to stratify our sample based on landscape types. The sites were
176 distributed across the national park and were chosen in anticipation of fu-
177 ture comparative research that is not reported here. Remote locations were
178 excluded if they did not yield more than the threshold of 2 visitors per hour.
179 Additional sites (e.g. Loch Chon, Loch Lubnaig, Loch Venachar) were added
180 on the advice of park managers keen to learn whether recent interventions to

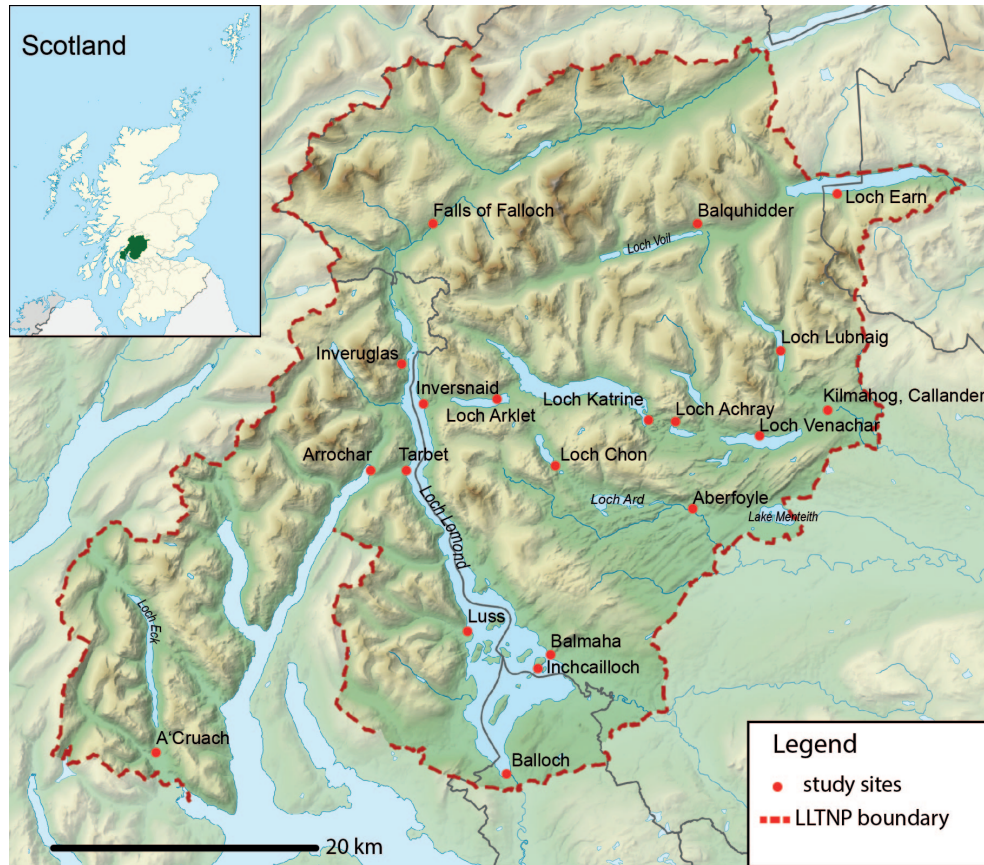


Figure 1: Locations of interview sites (base map credit: Nilfanion, licensed under Creative Commons CC BY-SA 3.0, contains Ordnance Survey data ©Crown copyright and database right, image accessed from <https://tinyurl.com/y97u9nqv>, 23.1.2018).

181 improve recreational experiences had improved visitor's perception of tran-
 182 quillity.

183 3.3. Field-based interviews about people's experience of tranquillity

184 To reduce the influence of weather condition and interviewer variation,
 185 the first author of this study conducted all interviews on relatively sunny
 186 days between 11th July and 3rd August 2017. We selected participants based
 187 on a convenience sample, while seeking to balance our sample with respect
 188 to age and gender. Respondents were asked the following open questions:
 189 'what makes this place more tranquil?', and 'what makes it less tranquil?'.
 190 Respondents were then asked to rate the tranquillity of the place where the

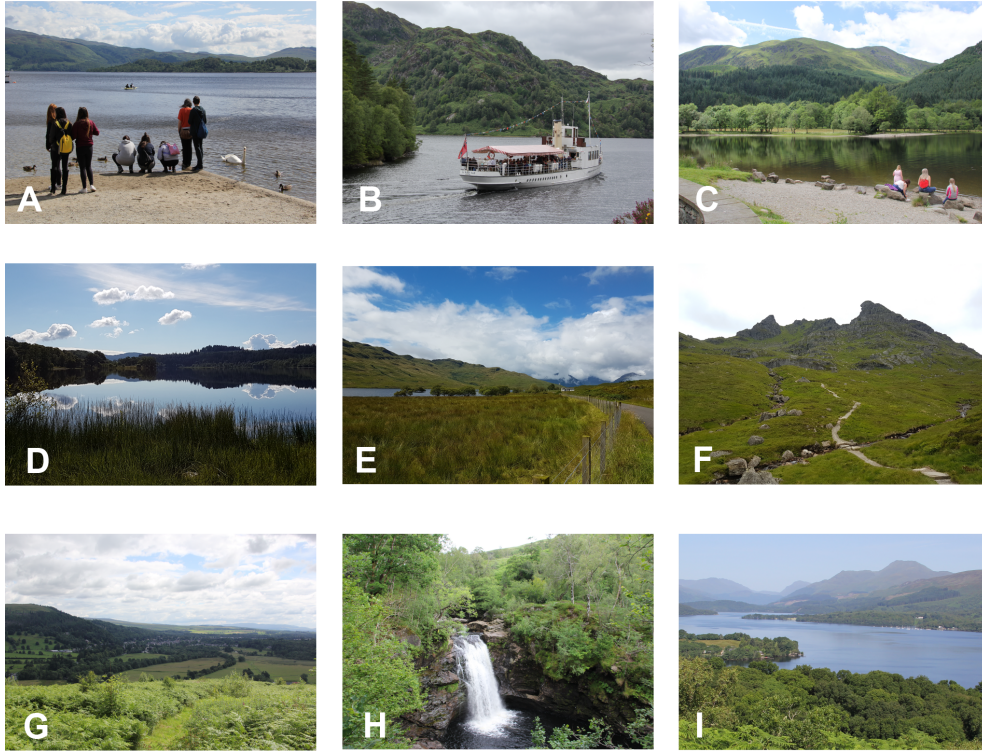


Figure 2: A: Tarbet, Loch Lomond; B: Loch Katrine; C: Loch Lubnaig; D: Loch Venachar; E: Loch Arklet; F: Ben Arthur, Arrochar; G: Callander and surrounding areas; H: Falls of Falloch; I: Inchcailloch, Loch Lomond

191 interview was conducted on a 5-point scale, where 1 was ‘not tranquil’ at
 192 all and 5 was ‘very tranquil’. Respondents were also asked to list places in
 193 the LLTNP that they thought were particularly tranquil, and to state what
 194 made them so. The question was repeated for places that they thought were
 195 not tranquil. The interview concluded with a set of closed questions about
 196 activities respondents conducted while in the national park, their frequency
 197 of visits, residency (classified as: within the LLTNP, elsewhere in Scotland,
 198 in the UK, outside UK), how they classified their current place of residence
 199 (urban, rural, or in between), age group, and gender.

200 3.4. *Analysing interview responses*

201 We applied ‘open coding’ (Crang and Cook, 2007), a method from social
 202 sciences to identify emerging themes in our data. With a list of topics we then
 203 conducted ‘structured coding’ (Crang and Cook, 2007), where all interview

204 statements are allocated to identified themes. Assuming the more a theme
205 was mentioned, the more important it was, we enumerated the number of
206 mentions per theme.

207 From the interview responses we then produced a list of terms according
208 to the frequency of mentions. From this list we removed negated expressions
209 (e.g. *not busy*, *no people*, *no trash*) and stop words (e.g. *they*, *only*, *it*,
210 *and*). We thus retained single terms that had positive connotations (e.g.
211 *peaceful*, *quiet*, *relaxation*, *water*), resulting in a list of 216 terms associated
212 with tranquillity.

213 3.5. *Modelling tranquillity from user-generated content*

214 We used content from the photosharing Flickr (www.flickr.com) as a
215 data source. On Flickr, registered users can upload images. These are often
216 titled and labelled with terms describing the image – so-called ‘tags’ (Fig.
217 3). The tags help other users find images, which provides an incentive for
218 users to provide accurate and meaningful tags so that their photos can be
219 ‘liked’ by other users. Tags encapsulate the atmosphere and experience of
220 the photographer, making them an interesting source of information to study
221 place-based experiences that, at the time of writing, was available free of
222 charge for research purposes. A proportion of images are also furnished with
223 geographic coordinates that enable us to spatially analyse their distribution.

224 We used the set of 216 keywords defined from interviews to search for
225 images on Flickr with tags that matched at least one of those keywords. We
226 accessed Flickr images through the Flickr Application Programming Interface
227 (API), which, for the terms selected, enabled us to retrieve georeferenced
228 images falling within a bounding box covering our study area. We accessed
229 the API through a Java-programme that we developed specifically for this
230 purpose. The resulting dataset consists of meta-information from images
231 matching the search criteria in the bounding box of the national park, which
232 include a set of decimal degree coordinates for each image, tags, title, date
233 taken, the URL of the image, and the username of the contributor. As a
234 preprocessing step we filtered bulk uploads. A bulk upload is where one user
235 adds many images with the same tags (Hollenstein and Purves, 2010), which
236 artificially increases the sample size without adding any new information.

237 To obtain information about how unexpected our result were, the distri-
238 bution of Flickr images with all selected tranquil tags (observed distribution
239 of Flickr images, *obs*) needs to be corrected for the overall underlying distri-
240 bution (expected distribution, all Flickr images, *exp*). We therefore applied

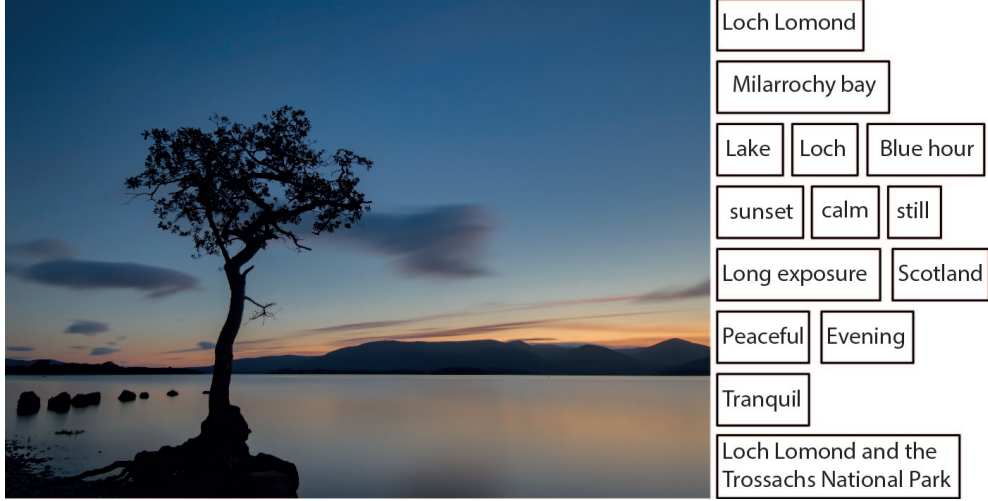


Figure 3: Users generate content in the form of images and text descriptions (tags). Image: ‘Blue Hour at Loch Millarochy’ by Rob Donnelly on Flickr.com, licensed under Creative Commons (CC BY-NC-ND 2.0)

241 correction methods reported in similar studies that use Flickr data (Hol-
 242 lenstein and Purves, 2010; Gschwend and Purves, 2012) and calculated a
 243 χ -expectation surface that highlights where we found more, equal or less
 244 content than expected as compared with the underlying distribution:

$$\chi = \frac{(obs - exp)}{\sqrt{exp}} \quad (1)$$

245 To generate the expected distribution (exp), we created a 1x1km grid cell
 246 raster. We chose a relatively large raster size because the content of an
 247 image might be reflective of the environment of both the local environment
 248 where the image was taken, not just the location itself. We then calculated
 249 the number of images per grid cell, both for images with selected tags (obs)
 250 and for all images (exp). We normalised the obs grid by multiplying each
 251 grid value by the total number of Flickr images in the bounding box divided
 252 by the total number of Flickr images in the dataset that contain that selected
 253 tag. We then calculated the χ -expectation surface. This expectation surface
 254 is based on our full list of terms from interviews positively connotated with
 255 tranquillity, representing a participant-based view of tranquillity.

256 3.6. *Comparing tranquillity map from user-generated content with field-based*
257 *tranquillity ratings and quiet area map*

258 We analysed tranquillity ratings from interview respondents using de-
259 scriptive statistics and tested for significant differences between mean tran-
260 quillity ratings at different interview locations, as well as between mean rat-
261 ings from people living in rural, urban and peri-urban settings. Since the
262 data were not normally distributed, we applied the non-parametric Kruskal-
263 Wallis test using a significance level of $\alpha = 0.05$. As a final step, we compared
264 our map showing the χ -expectation surface of images with all tags from in-
265 terviews positively associated with tranquillity with two other outputs: 1)
266 tranquillity ratings we collected from interview respondents in the field and
267 2) the map of quiet areas produced by the European Environmental Agency
268 (EEA, 2016b). This was done by visually assessing differences between the
269 different approaches.

270 4. Results and Interpretation

271 4.1. *Exploring tranquillity through interviews*

272 In total we interviewed 100 respondents, 49 women and 51 men. People
273 between 30 and 49 years were overrepresented in our sample ($n=40$), com-
274 pared to other age groups (18-29 years: $n=21$; 50-64 years: $n=18$; 65+ years:
275 $n=21$). The largest part of respondents lived in Scotland ($n=43$), followed
276 by international visitors from outside the UK ($n=35$). Eighteen respondents
277 lived elsewhere in the UK, and four were residents of the national park. For
278 46 respondents it was their first visit, while other respondents had visited the
279 park before with varying frequencies. The three main reasons for visiting the
280 park were hiking, enjoying the views and tranquillity. Fresh air and camping
281 were also mentioned, but to a lesser degree (Fig. 4).

282 We identified several themes that respondents thought made the interview
283 location more tranquil (Tab. 1). The absence of people was most prominently
284 mentioned, followed by the presence of certain landscape elements, such as
285 water bodies and mountains, and the absence of noise from traffic and other
286 disturbances. Other positively contributing factors were the presence of na-
287 ture and wildlife, as well as scenery and natural sounds. Furthermore, several
288 respondents stated that other people who behaved responsibly, and the ab-
289 sence of trash contributed to their feeling of tranquillity (Tab. 1). The most
290 frequently mentioned terms that were positively associated with tranquillity
291 included *water*, *tranquil*, and *nature*. When people described tranquil places

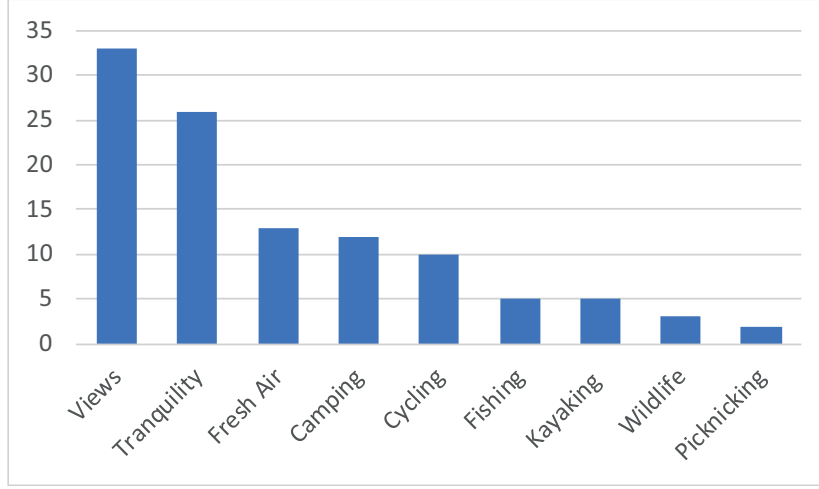


Figure 4: Reasons for visiting the national park (multiple answers were possible)

they also used terms that were semantically closely related to tranquillity, including: *atmosphere, calmness, peace, peaceful, pleasant, serene, serenity, tranquillity, tranquil, silence, silent, quiet*.

In contrast, the presence of people, and traffic was stated as making interview locations less tranquil (Tab. 2). Windy and rainy weather was also frequently mentioned as decreasing tranquillity.

4.2. Exploring perception of tranquillity through user-generated content

Using our terms extracted from interviews, we collected and retained a set of 22,082 images after pre-processing. User contribution was unequal (Max=780 images; Min=1 image; Mean=21.80; Median=2; ± 5.63) and showed a long-tail. For example, 3537 users each uploaded 10 images or less, while 21 users each uploaded over 100 images. The data set representing the complete underlying distribution for the study area contained 46,886 images after pre-processing, stemming from 6851 different users (Max=1081 images; Min=1 image; Mean=6.84; Median=2; ± 30.61).

The χ -expectation surface shows that people uploaded more pictures with tags relating to tranquillity around Loch Lomond and other freshwater bodies such as Loch Katrine, Loch Venachar and Loch Lubnaig than would be expected from all Flickr images uploaded (Fig. 5) indicating the experience of tranquillity may be linked to these landscape elements. Fewer images with tags related to tranquillity than expected were uploaded around settlements

Theme	No. of responses
Absence of people	38
Landscape elements	28
Absence of noise	21
Nature and wildlife	18
Scenery	14
Water	12
Change from everyday life	10
Absence of infrastructure	11
Friendly people	8
Fresh air	7
Absence of trash	4

Table 1: Interview responses for the question on ‘what makes this place more tranquil’

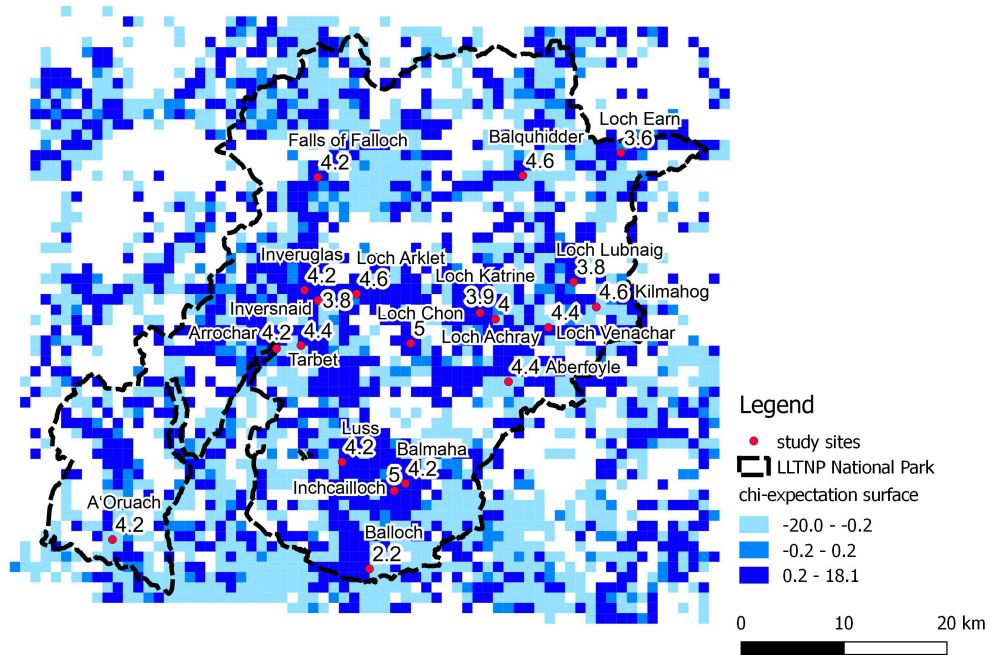


Figure 5: χ -expectation surface for Flickr images with all tags related to tranquillity and mean tranquillity ratings from respondents in the field (5: very tranquil, 1: not tranquil)

Theme	No. of re-sponses
Presence of people	39
Presence of traffic and infrastructure	29
Windy or rainy conditions	14
Antisocial behaviour	12
Anthropogenic noise	11
Litter	6
Time of year	3
Land use	2

Table 2: Interview responses for the question on ‘what makes this place less tranquil’

and towns such as Callander, Balloch, and Aberfoyle. At the shores of Loch Lomond near Balloch less content was uploaded than expected, despite the closeness to a water body. Other areas where we observe less images than expected despite the presence of water were Lake Menteith and the Western shore of Loch Earn at Lochearnhead. We also observe ‘white spots’ on the tranquillity map where there is no user-generated content available. We hypothesise these areas are either not photogenic, or are not accessed by users inclined to upload photos. The area North of Loch Katrine is not accessible by motorised transport and is characterised by glens and hills, suggesting this area might be challenging to access for many people. However, for the topographically challenging terrain between the Northernmost point of Loch Lomond and Loch Voil people uploaded content. This area is characterised by negative χ -values, indicating that there is less content related to tranquillity than expected from the overall distribution.

4.3. Field-based tranquillity ratings

Across the 20 interview locations, the mean perceived tranquillity rating was relatively high with 4.18 out of 5 (± 0.92 , median=4; N=100). The locations with highest rated tranquillity were the island of Inchcailloch in Loch Lomond and the campsite at the shores of Loch Chon, which were both rated 5 by all respondents. The lowest mean tranquillity rating for an interview location was 2.2 (± 0.45 ; n=5) at the shores of Loch Lomond in Balloch. There were significant differences between interview locations (Kruskal-Wallis $\chi^2=32.768$; $df=19$; $p=0.026$). Across all interview locations, we did not find differences in how people living in rural, urban or peri-urban

337 areas perceived tranquillity (Kruskal-Wallis $\chi^2=2.646$; $df=2$; $p=0.266$).

338 4.4. Comparing different approaches for mapping tranquillity

339 We first compare our approach based on user-generated content with the
340 *in situ* ratings we collected, before comparing both these results with the
341 map of ‘quiet areas’ (EEA, 2016b). Comparing the tranquillity ratings from
342 interviews in the field with the χ -expectation surface of user-generated con-
343 tent we observe the following: the interview locations are almost all located
344 in grid squares with positive χ -values, indicating more content semantically
345 related to tranquillity was uploaded in these squares. The highest tran-
346 quillity ratings from respondents coincide with relatively contiguous areas
347 of high χ -values, such as around Loch Chon and Inchcailloch. The low-
348 est tranquillity rating for Balloch is at the border of an area with negative
349 χ -values, suggesting lower perceived tranquillity. The tranquillity ratings
350 collected in the field thus correspond well with the χ -expectation map from
351 user-generated content, with some exceptions. For example, one site at the
352 Southwestern tip of the national park was rated as relatively tranquil (mean
353 rating of 4.2 out of 5), but is located in an area with negative χ -values. The
354 same applies to Kilmahog, near Callander. Thus, while the overall insights
355 we gain about areas perceived as tranquil correspond with the map from
356 user-generated content and respondents’ rating, user-generated content fails
357 to capture finer-grained nuances of the experience of tranquillity we capture
358 through interviews.

359 Comparing the map of tranquillity ratings from interview respondents
360 with the quiet area map (EEA, 2016b), we observe agreement over freshwater
361 bodies, which are considered highly tranquil/quiet, such as Loch Lomond,
362 Loch Katrine and Loch Chon (Fig. 6). However, stark contrasts between the
363 two maps exist in areas where major roads run alongside water bodies. The
364 quiet area map depicts this area with the lowest possible rating of quietness,
365 whereas participants rated most of these areas (except Balloch) 4 or higher
366 (out of 5). In some cases, the entire area of freshwater bodies is rated as the
367 lowest quietness index (such as Loch Earn), whereas respondents rated this
368 location as moderately tranquil (mean=3.6).

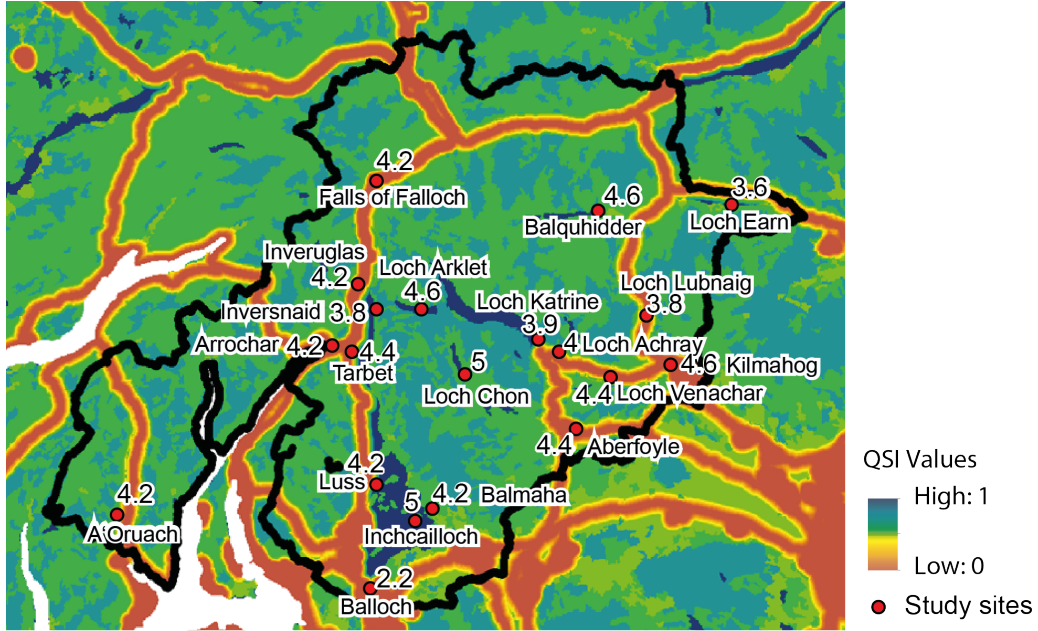


Figure 6: Quietness Suitability Index values (EEA, 2016a) overlaid with mean tranquillity ratings from respondents at study sites (5: very tranquil, 1: not tranquil)

5. Discussion

5.1. A hybrid methodology to assess and map experienced tranquillity

Our aim was to assess where people visiting a Scottish national park experience tranquillity using a combination of qualitative and quantitative approaches. Our results from interviews show that most respondents perceive tranquillity as a multi-sensory experience involving not only sound and sight, but also smell, as well as emotional responses to the environment. This is in line with previous research highlighting that tranquillity was influenced not only by sounds but also by visual stimuli (Watts and Pheasant, 2015b; Pheasant et al., 2010). The results of our qualitative interviews about factors contributing to tranquillity are in line with previous studies in England highlighting the importance of people and traffic (Jackson et al., 2008; Hewlett et al., 2017), although some nuances may be found in responses between different groups of people. For example, a tranquillity mapping study in the Dorset Area of Outstanding Natural Beauty showed how visitors rated traffic as a higher detractor from tranquillity as compared with the local residents (Hewlett et al., 2017). Although our interview results are in line with other

386 studies, in some instances they reveal locations experienced as being tran-
387 quill despite many people being present, and which were readily accessible by
388 motorised transport. We found high correspondence between the tranquillity
389 map based on UGC and the tranquillity ratings from respondents in the field
390 – suggesting that this form of UGC is a meaningful alternative to field based
391 interviews.

392 We found marked differences with an existing map of quiet areas (EEA,
393 2016b). While tranquillity ratings and the UGC map show tranquil areas
394 around freshwater bodies, often irrespective of roads nearby, the map of quiet
395 areas depicts these areas as heavily impacted by noise. One reason for these
396 differences may be that the maps of quiet areas allocate high importance
397 to detractors such as noise, whereas tranquillity as experienced in the field
398 seems to be less influenced by traffic noises, but more by perceived aesthetic
399 qualities of the visible surroundings. This suggests that people were able to
400 stand in a busy layby, ‘see’ past the noise, and allow the visual stimuli to
401 dominate their experience. In this way, a busy layby became a tranquil place.
402 This integrated experience may be different in field settings where people
403 have certain expectations about the areas they visit for recreation, compared
404 with controlled experiments, where anthropogenic noise was shown to reduce
405 tranquillity ratings of natural scenes (Watts and Pheasant, 2015b).

406 5.2. *From a potential for tranquillity towards experienced tranquillity*

407 In tandem with others, our findings suggest that the presence of other
408 people and the absence of noise are the main drivers for people’s experience
409 of tranquillity in outdoor settings. Landscape elements and characteristics
410 may play a prevalent role in conjuring up tranquillity despite the presence
411 of other people or traffic. Perhaps this experience in the outdoors differs
412 from how one imagines and describes an ideal tranquil setting during an
413 interview situation when at home or in a classroom. We thus propose to
414 distinguish two notions of tranquillity: ‘potential tranquillity’ is how people
415 imagine a tranquil place to be and how they describe such a place. This
416 notion of tranquillity can be modelled as areas where tranquillity can be
417 said to potentially exist, using GIS data and criteria such as remoteness
418 from infrastructure and people (Hewlett et al., 2017; Jackson et al., 2008).
419 The other notion is ‘experienced tranquillity’, namely areas where people
420 actually experience tranquillity. In this study we investigated experienced
421 tranquillity based on interviews in the field and user-generated content. Our
422 results show that areas of experienced tranquillity do not always overlap with

423 where potential tranquillity is said to exist. ‘Potential tranquillity’ models
424 identify remote mountain glens and hill tops with unobstructed views across
425 natural landscapes. These are highly tranquil areas. But only relatively few
426 people possess the motivation, willingness and abilities to physically reach
427 such areas. Analysis of our data showed that areas where tranquillity is
428 actually experienced by many people may be popular parking spots, or loch
429 sides next to roads or camp sites. Thus many people experience tranquillity
430 at the edges or boundaries of tranquil areas. Those edges are zones that
431 are easily accessed and retain enough of the properties to make them feel
432 tranquil. We suggest that such tranquil zones are thus more important to a
433 mass appreciation of tranquillity than the core areas of tranquil areas that
434 may have the highest level of perceived tranquillity (or quietness). Given
435 the emphasis on ‘tranquillity as perceived’, we argue that planning decisions
436 need to take account of the difference between areas most tranquil, and areas
437 where most people experience tranquillity. Levett (2000, p.13) observed that
438 many visitors to areas valued for their tranquillity ‘*never venture more than*
439 *a few hundred yards from car parks on busy roads*’; he concluded that by
440 exploring what kind(s) of access people want could satisfy a large number of
441 visitors without opening up more remote areas. Our findings showed that the
442 provision of amenable infrastructure (e.g. parking, picnic tables, maintained
443 walking paths to loch shores) close to roadsides provide opportunities for
444 many visitors to experience tranquillity. Such observations have important
445 implications for the identification and management of tranquil areas.

446 5.3. Implications

447 It is apparent that visitors to LLTNP experienced tranquillity along a
448 continuum. For example, the busy car park on a main road afforded just
449 as much self-reported tranquillity for many people as it did to the few who
450 make the long journey to a remote summit. Accommodating this broad spec-
451 trum of experiences within the planning process is very challenging. Do we
452 ‘pave over paradise’ and facilitate access for the many or do we use a no-
453 tion of tranquillity more akin to wilderness, and safeguard tranquillity by
454 limiting access to, and development of, such areas? We would argue they
455 are best resolved through participatory planning processes and consultations
456 with stakeholders. In order to provide the necessary information for such
457 decision-making processes in the form of spatial information we should in-
458 clude the complete continuum of tranquillity experiences. Doing so requires
459 the integration of different methodologies, including qualitative and quan-

titative approaches. There is increasing acceptance of the need to develop innovative hybrid methodologies that capture the experience of the public alongside those of experts in decision-making to increase participation – the benefits being ultimately a shared ownership in decision making, greater transparency and accountability (Arnstein, 1969; Sieber, 2006). Our research supports this idea, with the additional benefit of potentially accommodating a broader (less exclusionary) definition of tranquillity. Such broader definitions have the potential to guide decision-making in landscape management, though the question remains as to how different experiences of tranquillity are prioritised.

We acknowledge the considerable effort invested in processes of public engagement, but that environmentally deterministic models (typically using GIS) tend to exclude such experiences and opinions, because of their subjective (non-numerical) form (Thatcher et al., 2016). Leszczynski (2009) argues that the hunger to formalise tends to rule out the qualitative and the imposition of quantitative measures acts to constrain a richer description of place. More generally the failure to encapsulate people’s perceptions of place within GIS reflects a complex set of semantic and ontological issues that go beyond qualitative/quantitative debates. We argue it is not useful to see as a binary the difference between what is publicly experienced and what is represented in GIS models, but to integrate them into decision-making and thus deepen the debate.

5.4. *Contribution*

In our study, we explored the usability of social media in the form of user-generated tags for exploring tranquillity in space. Previous studies based on tags from user-generated content often used sets of tags defined by experts (van Zanten et al., 2016; Hollenstein and Purves, 2010), or described areas based on tag frequencies and other measures (Gschwend and Purves, 2012). The originality of our approach lies in the combination of field-based assessments of natural language terms people positively associate with tranquillity and user-generated content containing such terms. Such an approach allows the definition of tranquillity to emerge through the language respondents used in describing the concepts they associated with it, and thus addresses issues involved in expert-led, sometimes narrow, definitions of tranquillity. Furthermore, the spatial pattern revealed from user-generated content provides an additional perspective to tranquillity mapping (Hewlett et al., 2017;

496 Jackson et al., 2008). By comparing the map of user-generated content re-
497 lated to tranquillity with ratings collected from respondents in the field, we
498 provide an empirical evaluation of the efficacy of our approach. In the fol-
499 lowing, we highlight some limitations of our work and suggest avenues for
500 further research.

501 5.5. *Limitations and further work*

502 We conducted our fieldwork on relatively sunny summer days. However,
503 several respondents stated specifically that they would find the location more
504 tranquil if it was winter, or less tranquil if it was windier. This anecdotal evi-
505 dence suggests that environmental factors play an important role, and future
506 studies should explore this relationship, for example producing tranquillity
507 maps for different weather conditions. Another limitation is that our sample
508 of interview locations was based on pragmatic considerations related to the
509 number of visitors. This sample only covers a small part of the national park.
510 Furthermore, our sample of interview participants included mostly visitors
511 to the park, whereas local residents may hold different views on where tran-
512 quillity can be found (Hewlett et al., 2017). We did not find differences in
513 tranquillity ratings between people residing in urban and rural areas, which
514 could be due to relatively low sample size and the possible influence of fac-
515 tors we were unable to control in a field-setting. The relationship between
516 residential environment and the experience of tranquillity should therefore
517 be explored.

518 User-generated content such as Flickr data is increasingly being used as
519 a cost effective measure of sentiment, trends and activities (Tenkanen et al.,
520 2017), though authors have also cautioned against data analysis in the ab-
521 sence of theory in the age of ‘big data’ (Kitchin, 2014). The use of Flickr
522 (more specifically the tags and locations associated with the images) is biased
523 insofar that it is a sample, shaped by the technology and the data ontology
524 employed. Because we can only gain insights about experiences of people who
525 choose to share them through social media it is not a representative sample of
526 the overall population. Nonetheless, research is showing that such data pro-
527 vide information comparable with more cost-intensive approaches (Mancini
528 et al., 2018; Heikinheimo et al., 2017). These limitations notwithstanding, we
529 argue that user-generated content provides insights into tranquillity as per-
530 ceived, in a manner that is free of the constraints and bias of interviews and
531 questionnaires, whilst providing a sample size large enough for spatial analy-
532 sis. In future work we aim to scale up our approach to mapping tranquillity

533 with UGC to study experienced tranquillity across Scotland.

534 We chose Flickr for its unique combination of geolocation and semantic
535 content of tags, and although a range of other social media platforms could be
536 tested, they are likely to exhibit similar bias. To remedy these limitations,
537 we propose testing further data collection and elicitation methods. This
538 could be done using active inclusion of the public through a citizen science
539 approach, where people are invited to contribute by rating the tranquillity
540 of grid squares on a web map, or through smartphone applications at sample
541 points in the field. Additionally, other forms of UGC may be explored, such
542 as full-text hiking blogs, which include accounts of experiences of people
543 actively exploring the landscape (Wartmann et al., 2018). We also see value
544 in analysis of the images themselves; these can be processed using automated
545 image recognition and annotation to broaden the available data sources and
546 extend our analysis beyond the use of language associated with images.

547 6. Conclusion

548 Tranquillity is recognised as an important landscape quality that helps
549 ameliorate our stressful lives. Therefore various efforts have attempted to
550 incorporate notions of tranquillity into policy-making and planning. Hewlett
551 et al. (2017) acknowledge noise as an important factor influencing peoples
552 sense of tranquillity, commenting in their study site in Dorset, England that
553 'visitors considered traffic to be the most significant detractor from tran-
554 quillity' (2017, p.193). However, our study revealed that among the various
555 constituents of visitors to the Loch Lomond and The Trossachs National Park
556 in Scotland, many appeared able to set aside the impact of crowded spaces
557 and noise, and to experience tranquillity where models would predict none
558 existed. Such differences highlight 1) the need to avoid generalisation when
559 interpreting results from tranquillity modelling, and 2) the idea of tranquil-
560 lity as a social construct. It emphasises the need for broad consultation and
561 inclusivity in all aspects of protected area planning.

562 Although the broad and multi-sensory nature of tranquillity is commonly
563 acknowledged and has been empirically substantiated (Jackson et al., 2008;
564 Hewlett et al., 2017; Pheasant et al., 2010; Watts and Pheasant, 2015a,b),
565 tranquillity models have yet to incorporate more experience-based data. We
566 argue that user-generated content provides exciting possibilities in this re-
567 gard; the present study constitutes a first step towards harvesting such data
568 sources. The novelty of our approach lies in showing that by using not only

the locations of images, but investigating their semantic content through tags, we are able to identify areas of experienced tranquillity. While many critiques of the earliest tranquillity mapping approaches have been addressed as models have developed, further research is needed in order to build models that comprehensively incorporate people's notions and place-based experiences of tranquillity as a basis for planning and decision-making.

Exploring the notion of tranquillity is part of a broader debate on how we classify and value different landscapes (Cosgrove, 1984; De Groot et al., 2010; Stephenson, 2008), and how we both protect and provide access to them. A systematic approach to landscape characterisation and the identification of landscape qualities is a critical step to their conservation. Understanding the public's experience and imagining of landscape is critical to inclusive planning strategies – strategies made all the more important given increasing levels of urbanisation and associated loss of green space.

7. Disclaimer

The views and opinions expressed in this article are those of the authors alone, and do not necessarily reflect those of the institutions they work for or those of the Loch Lomond and the Trossachs National Park.

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